



INSTRUCTIONS

GENERAL INFORMATION

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INTRODUCTION

This section presents general information for Series-7 Locomotives. For more detailed data, refer to the overall maintenance manual furnished with the applicable model of locomotive.

SERIES-7 LOCOMOTIVES

General Electric's standard line of locomotives is shown in Fig. I-1. The Company has made a change in locomotive nomenclature, abandoning the traditional U-designation for an identification system felt to be more meaningful. The change in nomenclature applies across the standard domestic line.

As in the past, the letter still indicates the number of axles i.e., "B" is the standard two-axle two-motor truck, and "C" indicates a three-axle three-motor truck. The number following the truck identification represents the

horsepower input for traction. The last number, in this case, "7," indicates the first model year i.e., 197"7."

The Series-7 retains the standard locomotive underframes and diesel engines. The 7FDL8 engine for the 1800 hp class; the 7FDL12 engine for the 2250 and 2750 hp class; and the 7FDL16 for the 3000, 3300 and 3600 hp class.

The 7FDL8 is an 8-cylinder engine, the 7FDL12 is a 12-cylinder engine and the 7FDL16 is a 16-cylinder engine.

GENERAL DATA

Table I-I lists the general data for each Series-7 locomotive model.

CONVERSION FACTORS

U.S. WEIGHTS AND MEASURES

Measures of Length

1 mile = 1760 yards = 5280 feet.
 1 yard = 3 feet = 36 inches.
 1 foot = 12 inches.
 1 mil = 0.001 inch.
 1 fathom = 2 yards = 6 feet.
 1 rod = 5.5 yards = 16.5 feet.
 1 hand = 4 inches.
 1 span = 9 inches.
 1 micro-inch = one millionth inch or 0.000001 inch.
 (1 micron = One millionth meter = 0.00003937 inch.)

Surveyor's Measure

1 mile = 8 furlongs = 80 chains.
 1 furlong = 10 chains = 220 yards.
 1 chain = 4 rods = 22 yards = 66 feet = 100 links.
 1 link = 7.92 inches.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

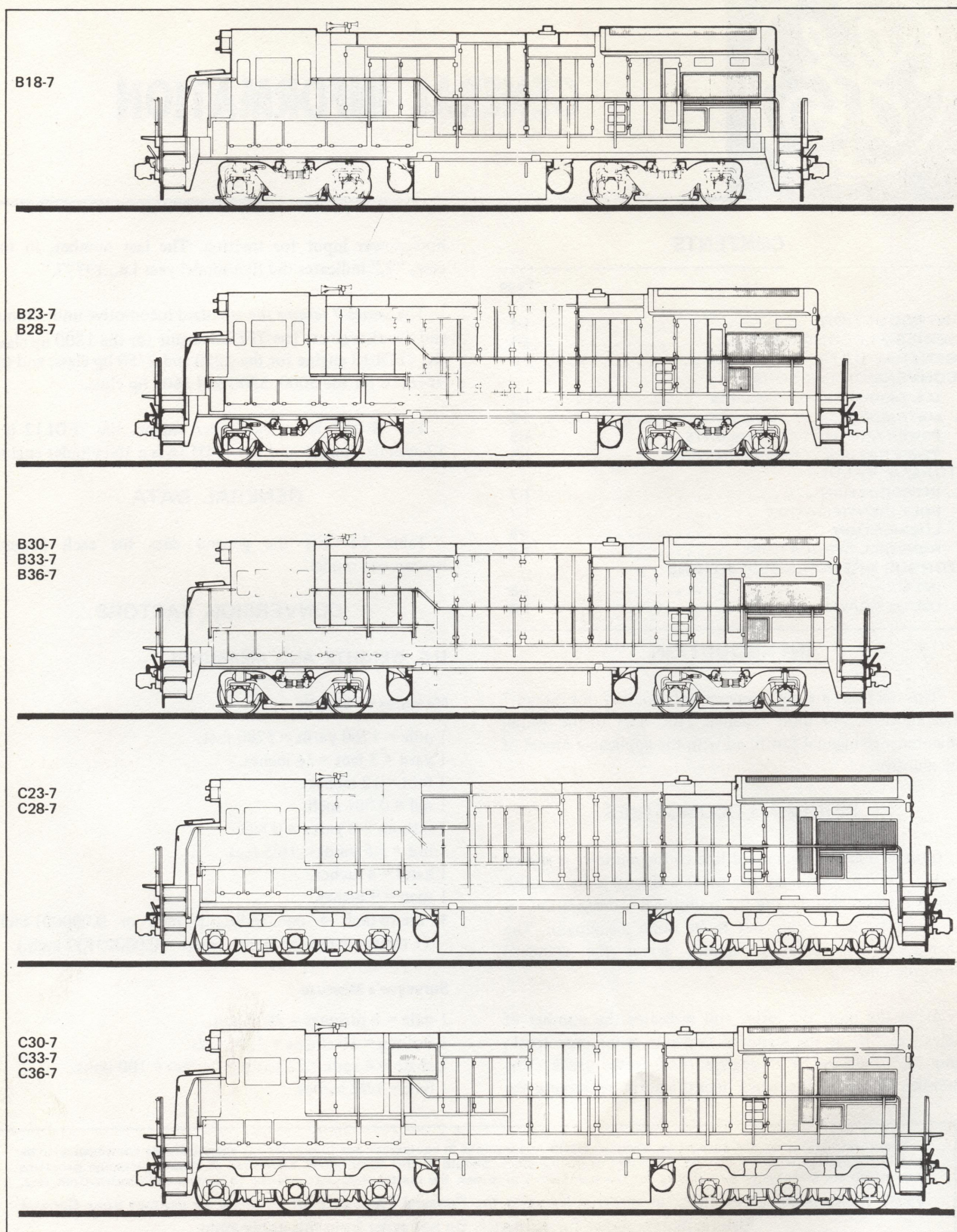


FIG. I-1. SERIES-7 LOCOMOTIVES.

FIG. I-1, E-24520

TABLE I-I, GENERAL DATA

	Model								
	B18-7	B23-7	C23-7	B28-7	C28-7	B30-7	C30-7	B36-7	C36-7
Horsepower (Net)	1800	2250	2250	2750	2750	3000	3000	3600	3600
Type (ARR Symbol)	B-B	B-B	C-C	B-B	C-C	B-B	C-C	B-B	C-C
Engine	GE-FDL8	GE-FDL12	GE-FDL12	GE-FDL12	GE-FDL12	GE-FDL16	GE-FDL16	GE-FDL16	GE-FDL16
Major Dimensions									
Length	56 ft.-8 in.	62 ft.-2 in.	67 ft.-3 in.	62 ft.-2 in.	67 ft.-3 in.	62 ft.-2 in.	67 ft.-3 in.	62 ft.-2 in.	67 ft.-3 in.
Width	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.	10 ft.-3-1/4 in.
Height	14 ft.-9-1/4 in.	14 ft.-9-1/4 in.	15 ft.-4-1/4 in.	14 ft.-9-1/4 in.	15 ft.-4-1/4 in.	14 ft.-9-1/4 in.	15 ft.-4-1/4 in.	14 ft.-9-1/4 in.	15 ft.-4-1/4 in.
Length Between Bolster Centers	30 ft.-8 in.	36 ft.-2 in.	40 ft.-11 in.	36 ft.-2 in.	40 ft.-11 in.	36 ft.-2 in.	40 ft.-11 in.	36 ft.-2 in.	40 ft.-11 in.
Truck Wheel Base	9 ft.-0 in.	9 ft.-0 in.	13 ft.-7 in.	9 ft.-0 in.	13 ft.-7 in.	9 ft.-0 in.	13 ft.-7 in.	9 ft.-0 in.	13 ft.-7 in.
Minimum Curve									
Locomotive Alone	150 ft. or 39°	150 ft. or 39°	273 ft. or 21°	150 ft. or 39°	273 ft. or 21°	150 ft. or 39°	273 ft. or 21°	150 ft. or 39°	273 ft. or 21°
Coupled to Train	250 ft. or 23°	250 ft. or 23°	273 ft. or 21°	250 ft. or 23°	273 ft. or 21°	250 ft. or 23°	273 ft. or 21°	250 ft. or 23°	273 ft. or 21°
Drive									
Traction Motors	Four GE-752	Four GE-752	Six GE-752	Four GE-752	Six GE-752	Four GE-752	Six GE-752	Four GE-752	Six GE-752
Wheel Diameter	40 in.	40 in.	40 in.	40 in.	40 in.	40 in.	40 in.	40 in.	40 in.
Weight (Typical)									
Minimum	230,600 lb.	253,000 lb.	359,000 lb.	253,000 lb.	359,000 lb.	259,000 lb.	366,000 lb.	259,800 lb.	366,600 lb.
Maximum	268,000 lb.	280,000 lb.	420,000 lb.	280,000 lb.	420,000 lb.	280,000 lb.	420,000 lb.	280,000 lb.	420,000 lb.
Supplies									
Fuel Min./Max.	1200/2150 gal.	2150/3250 gal.	3250/4000 gal.	2150/3250 gal.	3250/4000 gal.	2150/3250 gal.	3250/4000 gal.	2150/3250 gal.	3250/4000 gal.
Cooling Water	335 gal.	350 gal.	350 gal.	350 gal.	350 gal.	365 gal.	365 gal.	365 gal.	365 gal.
Lubricating Oil	245 gal.	300 gal.	300 gal.	300 gal.	300 gal.	380 gal.	380 gal.	380 gal.	380 gal.
Governor Oil	2 qt.	2 qt.	2 qt.	2 qt.	2 qt.	2 qt.	2 qt.	2 qt.	2 qt.
Sand	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.	60 cu. ft.

Square Measure

- 1 square mile = 640 acres = 6400 square chains.
 1 acre = 10 square chains = 4840 square yards = 43,560 square feet.
 1 square chain = 16 square rods = 484 square yards = 4356 square feet.
 1 square rod = 30.25 square yards = 272.25 square feet = 625 square links.
 1 square yard = 9 square feet.
 1 square foot = 144 square inches.

An acre is equal to a square, the side of which is 208.7 feet.

Measure Used for Diameters and Areas of Electric Wires

- 1 circular inch = area of circle 1 inch in diameter = 0.7854 square inch.
 1 circular inch = 1,000,000 circular mils.
 1 square inch = 1.2732 circular inch = 1,273,239 circular mils.

A circular mil is the area of a circle 0.001 inch in diameter.

Cubic Measure

- 1 cubic yard = 27 cubic feet.
 1 cubic foot = 1728 cubic inches.

The following measures are also used for wood and masonry:

- 1 cord of wood = 4 x 4 x 8 feet = 128 cubic feet.

- 1 perch of masonry = 16-1/2 x 1-1/2 x 1 foot = 24-3/4 cubic feet.

Liquid Measure

- 1 U.S. gallon = 0.1337 cubic foot = 231 cubic inches = 4 quarts = 8 pints.
 1 quart = 2 pints = 8 gills.
 1 pint = 4 gills.
 1 British Imperial gallon = 1.2009 U.S. gallon = 277.42 cubic inches.
 1 cubic foot = 7.48 U.S. gallons.

Measures of Weight (Avoirdupois or Commercial Weight)

- 1 gross or long ton = 2240 pounds.
 1 net or short ton = 2000 pounds.
 1 pound = 16 ounces = 7000 grains.
 1 ounce = 16 drachms = 437.5 grains.

Measures of Pressure

- 1 pound per square inch = 144 pounds per square foot = 0.068 atmosphere = 2.042 inches of mercury at 62 degrees F = 27.7 inches of water at 62 degrees F = 2.31 feet of water at 62 degrees F.
 1 atmosphere = 30 inches of mercury at 62 degrees F = 14.7 pounds per square inch = 2116.3 pounds per square foot = 33.95 feet of water at 62 degrees F.
 1 foot of water at 62 degrees F = 62.355 pounds per square foot = 0.433 pound per square inch.
 1 inch of mercury at 62 degrees F = 1.132 foot of water = 13.58 inches of water = 0.491 pound per square inch.

METRIC SYSTEM OF MEASUREMENT

In the metric system of measurements, the principal unit for length is the meter; the principal unit for capacity, the liter; and the principal unit for weight, the gram. The following prefixes are used for subdivisions and multiples: milli = 1/1000; centi = 1/100; deci = 1/10; deka = 10; hecto = 100; kilo = 1000. In abbreviations, both the subdivisions and the multiples are used with a small or lower case letter.

All the multiples and subdivisions are not used commercially. Those ordinarily used for length are kilometer, meter, centimeter and millimeter; for capacity, square meter, square centimeter, and square millimeter; for cubic measures, cubic meter, cubic decimeter (liter), cubic centimeter, and cubic millimeter. The most commonly used weights are the kilogram and gram.

Measures of Length

10 millimeters (mm)	= 1 centimeter (cm).
10 centimeters	= 1 decimeter (dm).
10 decimeters	= 1 meter (m).
1000 meters	= 1 kilometer (km).

Square Measure

100 square millimeters (mm ²)	= 1 square centimeter (cm ²).
100 square centimeters	= 1 square decimeter (dm ²).
100 square decimeters	= 1 square meter (m ²).

Surveyor's Square Measure

100 square meters (m ²)	= 1 are (a).
100 ares	= 1 hectare (ha).
100 hectares	= 1 square kilometer (km ²).

Cubic Measure

1000 cubic millimeters (mm ³)	= 1 cubic centimeter (cm ³).
1000 cubic centimeters	= 1 cubic decimeter (dm ³).
1000 cubic decimeters	= 1 cubic meter (m ³).

Dry and Liquid Measure

10 milliliters (ml)	= 1 centiliter (cl).
10 centiliters	= 1 deciliter (dl).
10 deciliters	= 1 liter (l).
100 liters	= 1 hectoliter (hl).
1 liter = 1 cubic decimeter = the volume of 1 kilogram of pure water at a temperature of 39.2 degrees F.	

Measures of Weight

10 milligrams (mg)	= 1 centigram (cg).
10 centigrams	= 1 decigram (dg).
10 decigrams	= 1 gram (g).
10 grams	= 1 dekagram (dag).
10 dekagrams	= 1 hectogram (hg).
10 hectograms	= 1 kilogram (kg).
1000 kilograms	= 1 (metric) ton (t).

Metric and English Conversion TableLinear Measure

1 kilometer = 0.6214 mile.	1 mile = 1.609 kilometers.
1 meter = $\begin{cases} 39.37 \text{ inches.} \\ 3.2808 \text{ feet.} \\ 1.0936 \text{ yards.} \end{cases}$	1 yard = 0.9144 meter.
	1 foot = 0.3048 meter.
1 centimeter = 0.3937 inch.	1 foot = 304.8 millimeters.
1 millimeter = 0.03937 inch.	1 inch = 2.54 centimeters.
	1 inch = 25.4 millimeters.

Square Measure

1 square kilometer = 0.3861 square mile = 247.1 acres.
1 hectare = 2.471 acres = 107,639 square feet.
1 are = 0.0247 acre = 1076.4 square feet.
1 square meter = 10.764 square feet = 1.196 square yards.
1 square centimeter = 0.155 square inch.
1 square millimeter = 0.00155 square inch.

1 square mile = 2.5899 square kilometers.
1 acre = 0.4047 hectare = 40.47 ares.
1 square yard = 0.836 square meter.
1 square foot = 0.0929 square meter = 929 square centimeters.
1 square inch = 6.452 square centimeters = 645.2 square millimeters.

Cubic Measure

1 cubic meter = 35.315 cubic feet = 1.308 cubic yards.
1 cubic meter = 264.2 U.S. gallons.
1 cubic centimeter = 0.061 cubic inch.
1 liter (cubic decimeter) = 0.0353 cubic foot = 61.023 cubic inches.
1 liter = 0.2642 U.S. gallon = 1.0567 U.S. quarts.
1 cubic yard = 0.7646 cubic meter.
1 cubic foot = 0.02832 cubic meter = 28.317 liters.
1 cubic inch = 16.38706 cubic centimeters.
1 U.S. gallon = 3.785 liters.
1 U.S. quart = 0.946 liter.

Weight

- 1 metric ton = 0.9842 ton (of 2240 pounds) = 2204.6 pounds.
 1 kilogram = 2.2046 pounds = 35.274 ounces avoirdupois.
 1 gram = 0.03215 ounce troy = 0.03527 ounce avoirdupois.
 1 gram = 15.432 grains.
- 1 ton (of 2240 pounds) = 1.016 metric ton = 1016 kilograms.
 1 pound = 0.4536 kilogram = 453.6 grams.
 1 ounce avoirdupois = 28.35 grams.
 1 ounce troy = 31.103 grams.
 1 grain = 0.0648 gram.
- 1 kilogram per square millimeter = 1422.32 pounds per square inch.
 1 kilogram per square centimeter = 14.223 pounds per square inch.
 1 kilogram-meter = 7.233 pounds-foot.
 1 pound per square inch = 0.0703 kilogram per square centimeter.
 1 calorie (kilogram calorie) = 3.968 Btu (British thermal unit).

POWER AND HEAT EQUIVALENTS

- 1 horsepower-hour = 0.746 kilowatt-hour = 1,980,000 foot-pounds = 2545 Btu (British thermal unit) = 2.64 pounds of water evaporated at 212 F = 17 pounds of water raised from 62 to 212 F.
- 1 kilowatt-hour = 1000 watt-hours = 1.34 horsepower-hour = 2,655,200 foot-pounds = 3,600,000 joules = 3415 Btu = 3.54 pounds of water evaporated at 212 F = 22.8 pounds of water raised from 62 to 212 F.
- 1 horsepower = 746 watts = 0.746 kilowatt = 33,000 foot-pounds per minute = 550 foot-pounds per second = 2545 Btu per hour = 42.4 Btu per minute = 0.71 Btu per second = 2.64 lbs. of water evaporated per hour at 212 F.
- 1 kilowatt = 1000 watts = 1.34 horsepower = 2,655,200 foot-pounds per hour = 44,200 foot-pounds per minute = 737 foot-pounds per second = 3415 Btu per hour = 57 Btu per minute = 0.95 Btu per second = 3.54 pounds of water evaporated per hour at 212 F.
- 1 watt = 1 joule per second = 0.00134 horsepower = 0.001 kilowatt = 3.42 Btu per hour = 44.22 foot-pounds per minute = 0.74 foot-pounds per second = 3.54 pounds of water evaporated per hour at 212 F.
- 1 Btu = 1052 watt-seconds = 778 foot-pounds = 0.252 kilogram-calorie = 0.000292 kilowatt-hour = 0.000393 horsepower-hour = 0.00104 pound of water evaporated at 212 F.
- 1 foot-pound = 1.36 joule = 0.000000377 kilowatt-hour = 0.00129 Btu = 0.0000005 horsepower-hour.
- 1 joule = 1 watt-second = 0.000000278 kilowatt-hour = 0.00095 Btu = 0.74 foot-pound.

TEMPERATURE CONVERSION TABLE**Thermometer Scales**

There are three thermometer scales in general use: the Fahrenheit (F), which is generally used in the English speaking countries; the Centigrade (C) or Celsius, which is used in several continental countries and in scientific work; and the Réaumur (R), which is used to some extent on the European continent.

In the Fahrenheit thermometer, the freezing point of water is marked at 32 degrees on the scale and the boiling point, at atmospheric pressure, at 212 degrees. The distance between these two points is divided into 180 degrees. On the Centigrade scale, the freezing point of water is at 0 degrees and the boiling point at 100 degrees. On the Réaumur scale, the freezing point is at 0 degrees and the boiling point at 80 degrees. The following formulas may be used for converting temperatures given on any one of the scales to the other scales:

Degrees Fahrenheit =

$$\frac{9 \times \text{degrees C}}{5} + 32 = \frac{9 \times \text{degrees R}}{4} + 32.$$

Degrees Centigrade =

$$\frac{5 \times (\text{degrees F} - 32)}{9} = \frac{5 \times \text{degrees R}}{4}$$

Degrees Réaumur =

$$\frac{4 \times \text{degrees C}}{5} = \frac{4 \times (\text{degrees F} - 32)}{9}$$

Table I-II is for converting degrees Centigrade into degrees Fahrenheit. The tables can, of course, be conveniently used in the reverse order.

Absolute Temperature and Absolute Zero

A point has been determined on the thermometer scale, by theoretical considerations, which is called the absolute zero and beyond which a further decrease in temperature is inconceivable. This point is located at -273.2 degrees Centigrade or 459.7 degrees Fahrenheit. A temperature reckoned from this point, instead of from zero on the ordinary thermometers, is called absolute temperature. Absolute temperature in degrees C is known as "degrees Kelvin" or the "Kelvin scale" (K) and absolute temperature in degrees F is known as "degrees Rankine" or the "Rankine scale" (R).

$$\text{Degrees Kelvin} = \text{degrees C} + 273.2$$

$$\text{Degrees Rankine} = \text{degrees F} + 459.7$$

TABLE I-II, COMPARISON BETWEEN CENTIGRADE AND FAHRENHEIT

Deg. C	Deg. F	Deg. C	Deg. F	Deg. C	Deg. F	Deg. C	Deg. F	Deg. C	Deg. F	Deg. C	Deg. F
-40	-40.0	8	46.4	56	132.8	104	219.2	152	305.6	200	392.0
-39	-38.2	9	48.2	57	134.6	105	221.0	153	307.4	201	393.8
-38	-36.4	10	50.0	58	136.4	106	222.8	154	309.2	202	395.6
-37	-34.6	11	51.8	59	138.2	107	224.6	155	311.0	203	397.4
-36	-32.8	12	53.6	60	140.0	108	226.4	156	312.8	204	399.2
-35	-31.0	13	55.4	61	141.8	109	228.2	157	314.6	205	401.0
-34	-29.2	14	57.2	62	143.6	110	230.0	158	316.4	206	402.8
-33	-27.4	15	59.0	63	145.4	111	231.8	159	318.2	207	404.6
-32	-25.6	16	60.8	64	147.2	112	233.6	160	320.0	208	406.4
-31	-23.8	17	62.6	65	149.0	113	235.4	161	321.8	209	408.2
-30	-22.0	18	64.4	66	150.8	114	237.2	162	323.6	210	410.0
-29	-20.2	19	66.2	67	152.6	115	239.0	163	325.4	211	411.8
-28	-18.4	20	68.0	68	154.4	116	240.8	164	327.2	212	413.6
-27	-16.6	21	69.8	69	156.2	117	242.6	165	329.0	213	415.4
-26	-14.8	22	71.6	70	158.0	118	244.4	166	330.8	214	417.2
-25	-13.0	23	73.4	71	159.8	119	246.2	167	332.6	215	419.0
-24	-11.2	24	75.2	72	161.6	120	248.0	168	334.4	216	420.8
-23	-9.4	25	77.0	73	163.4	121	249.8	169	336.2	217	422.6
-22	-7.6	26	78.8	74	165.2	122	251.6	170	338.0	218	424.4
-21	-5.8	27	80.6	75	167.0	123	253.4	171	339.8	219	426.2
-20	-4.0	28	82.4	76	168.8	124	255.2	172	341.6	220	428.0
-19	-2.2	29	84.2	77	170.6	125	257.0	173	343.4	221	429.8
-18	-0.4	30	86.0	78	172.4	126	258.8	174	345.2	222	431.6
-17	+ 1.4	31	87.8	79	174.2	127	260.6	175	347.0	223	433.4
-16	3.2	32	89.6	80	176.0	128	262.4	176	348.8	224	435.2
-15	5.0	33	91.4	81	177.8	129	264.2	177	350.6	225	437.0
-14	6.8	34	93.2	82	179.6	130	266.0	178	352.4	226	438.8
-13	8.6	35	95.0	83	181.4	131	267.8	179	354.2	227	440.6
-12	10.4	36	96.8	84	183.2	132	269.6	180	356.0	228	442.4
-11	12.2	37	98.6	85	185.0	133	271.4	181	357.8	229	444.2
-10	14.0	38	100.4	86	186.8	134	273.2	182	359.6	230	446.0
-9	15.8	39	102.2	87	188.6	135	275.0	183	361.4	231	447.8
-8	17.6	40	104.0	88	190.4	136	276.8	184	363.2	232	449.6
-7	19.4	41	105.8	89	192.2	137	278.6	185	365.0	233	451.4
-6	21.2	42	107.6	90	194.0	138	280.4	186	366.3	234	453.2
-5	23.0	43	109.4	91	195.8	139	282.2	187	368.6	235	455.0
-4	24.8	44	111.2	92	197.6	140	284.0	188	370.4	236	456.8
-3	26.6	45	113.0	93	199.4	141	285.8	189	372.2	237	458.6
-2	28.4	46	114.8	94	201.2	142	287.6	190	374.0	238	460.4
-1	30.2	47	116.6	95	203.0	143	289.4	191	375.8	239	462.2
0	32.0	48	118.4	96	204.8	144	291.2	192	377.6	240	464.0
+ 1	33.8	49	120.2	97	206.6	145	293.0	193	379.4	241	465.8
2	35.6	50	122.0	98	208.4	146	294.8	194	381.2	242	467.6
3	37.4	51	123.8	99	210.2	147	296.6	195	383.0	243	469.4
4	39.2	52	125.6	100	212.0	148	298.4	196	384.8	244	471.2
5	41.0	53	127.4	101	213.8	149	300.2	197	386.6	246	474.8
6	42.8	54	129.2	102	215.6	150	302.0	198	388.4	248	478.4
7	44.6	55	131.0	103	217.4	151	303.8	199	390.2	250	482.0

Measures of the Quantity of Heat

The unit of quantity of heat used in the English speaking countries is the British thermal unit, which is the quantity of heat required to raise the temperature of one pound of pure water one degree F. (American Standard abbreviation, Btu; conventional British symbol, B.Th.U.). The French thermal unit or kilogram calorie, is the quantity of heat required to raise the temperature of one kilogram of pure water one degree C. One kilogram calorie = 3.968 British thermal units = 1000 gram calories.

The number of foot-pounds of mechanical energy equivalent to one British thermal unit is called the mechanical equivalent of heat, and equals 778 foot-pounds. One foot-pound equals 0.001285 heat unit.

TORQUE VALUES

(Medium Carbon and Alloy Steel Bolts)

INTRODUCTION

Use the torque values in Table I-III as a guide to insure satisfactory tightening of the bolts, studs and their nuts where a specific value is NOT given in Table I-I, General Data of the instructions, or on a maintenance data plate on the equipment part being maintained.

BOLT IDENTIFICATION

Bolts may be identified in the following manner:

MEDIUM CARBON STEEL:

Three radial dashes on head



ALLOY STEEL:

Six radial dashes on head



or "X" stamped on head



TABLE I-III, TORQUE VALUES

Bolt Diameter	Threads Per Inch	Torque Values*			
		Medium Carbon (SAE Grade 5)		Alloy Steel (SAE Grade 8)**	
		 Lb.-Ft.	N-m	 Lb.-Ft.	N-m
1/4	20	5-8	7-11	10-12	14-16
	28	5-8	7-11	10-12	14-16
5/16	18	12-15	16-20	18-21	24-28
	24	12-15	16-20	20-23	27-31
3/8	16	20-25	27-34	30-36	41-49
	24	25-28	34-38	34-40	46-54
7/16	14	35-40	47-54	50-56	68-76
	20	40-45	54-61	60-65	81-88
1/2	13	55-60	75-81	80-90	108-122
	20	60-70	81-95	95-105	129-142
9/16	12	75-80	102-108	110-123	149-167
	18	90-100	122-136	130-145	176-197
5/8	11	105-115	142-156	152-169	206-229
	18	125-140	169-190	185-205	251-278
3/4	10	185-205	251-278	285-315	386-427
	16	220-245	298-332	340-370	461-502
7/8	9	300-330	407-447	440-490	597-664
	14	340-380	461-515	510-565	691-766
1	8	440-490	597-664	685-735	929-997
	12	530-570	719-773	790-865	1071-1173
1-1/8	7	620-690	841-936	935-1040	1268-1410
	12	750-830	1017-1125	1115-1240	1512-1681
1-1/4	7	890-990	1206-1342	1250-1360	1695-1844
	12	1040-1160	1410-1573	1600-1750	2169-2373
1-3/8	6	1160-1290	1573-1749	1745-1940	2366-2630
	12	1420-1580	1925-2142	2125-2360	2881-3200
1-1/2	6	1570-1740	2129-2359	2300-2600	3118-3525
	12	1800-2000	2440-2712	2600-3020	3525-4095

*Read the following information before using this table.

**Includes socket head capscrews.

LUBRICATION

To get maximum benefit from applied torque, the threads and the underside of the bolt head should be clean from dirt, rust areas and scale from heat treating.

Bolts should be lubricated with a high-pressure lubricant such as graphite in oil or white lead in oil (mixed approximately five parts machine oil to one part graphite or white lead, by volume). Lubriplate* (Part 147X1614), Molykote** (Part 147X1143), Dag 210*** (Part 147X1613) or anti-seize compound (Part 147X1640) may also be used. Always lubricate both the threads and washer face of bolts and nuts.

NOTE: *Hardened, flat washers are recommended for medium carbon bolts and are mandatory for alloy steel bolt applications.*

NONSTEEL APPLICATIONS

When aluminum, copper or other soft metals are being bolted together, care must be taken to use larger washers, smaller bolts, or lower torques in order to prevent deformation of the softer materials. The softer metals also have more of a tendency to relax with time; retorquing at least once is recommended.

If using an extension on the torque wrench, refer to TORQUE WRENCH APPLICATIONS section.

CAUTION: *The Torque Values Table gives approximate maximum and minimum values that should be applied to the bolts of the size and material indicated. These values take only bolt strength into consideration and are applicable for steel-to-steel joints. When material is softer than steel, such as brass, aluminum, plastic, etc., thread stripping is a possibility if the table values of torque are used. These values may also be excessive for many gasketed joints, since extrusion of the gasket may result.*

Also consider the following when using the tables:

1. Torque wrenches are a possible source of error and should be checked often. If out of calibration more than $\pm 5\%$, they should be adjusted.

2. Dry (unlubricated) assemblies of bolts and nuts may require up to 20% additional torque. If threads are not clean, the values may be higher yet.
3. Well-rolled and lubricated bolts going into smooth threads in a tapped hole could require as much as 20% less torque than that shown in the table. Cadmium plating will also reduce the charted torque.

TORQUE WRENCH APPLICATIONS

INTRODUCTION

To insure satisfactory performance of mechanical equipment and to avoid costly failures, it is important to tighten all nuts on vital bolts and studs according to values given in the appropriate instructions. When a torque wrench is not available, it may be assumed a man can exert a pull of about 125 pounds on a wrench handle which, when multiplied by the wrench length in feet, gives the torque produced in lb.-ft.

USE OF ADAPTERS

It is often necessary to use adapters with a torque wrench to reach inaccessible bolts or nuts. When adapters are used, the reading of the torque wrench dial is not the actual torque exerted. The additional torque exerted on the nut or bolt (over that shown on dial) depends on:

1. Length of the adapter
2. Angle at which adapter is positioned on wrench.

See Figs. I-2 and I-3 for calculation of correction factor to be applied to dial readings.

NOTE: *It is important the pull on the torque wrench handle be concentrated at the position marked "P" in Figs. I-2 and I-3. A shift in this position will cause considerable error in the effective torque at the end of the adapter. It is also very important the threads of both parts be clean, free of burrs, and properly lubricated. The contact face of a nut or bolt must also be lubricated with the same lubricant.*

*Product of Fiske Bros. Refining Co., Newark, N.J.

**Registered trademark of Dow Corning Corp.

***Acheson Colloids Co., Port Huron, Mich.

FIG. I-2, E-11813A

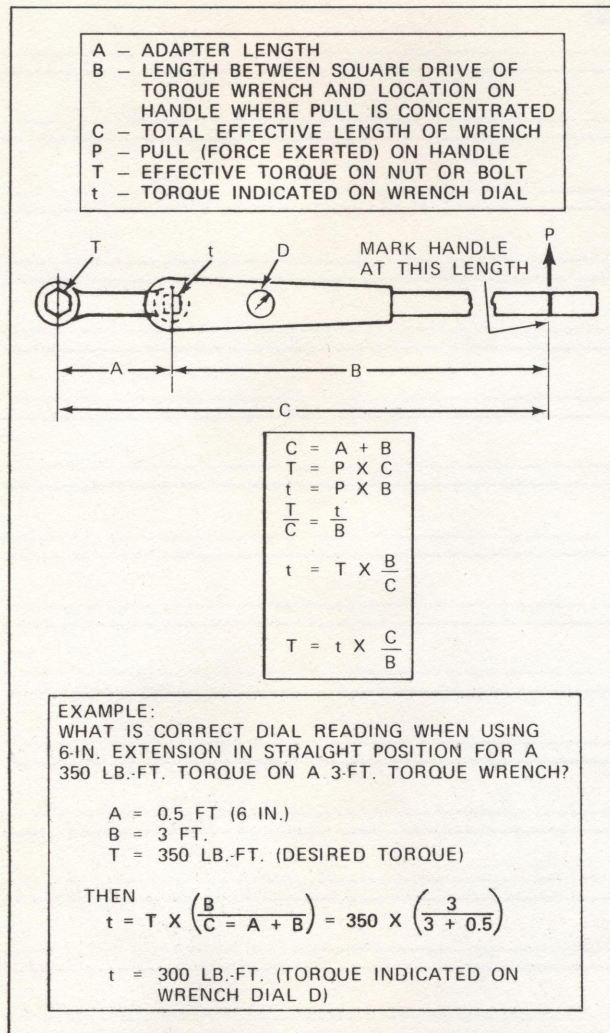


FIG. I-2. USING TORQUE WRENCH WITH ADAPTER APPLIED IN STRAIGHT POSITION.

FIG. I-3, E-11814A

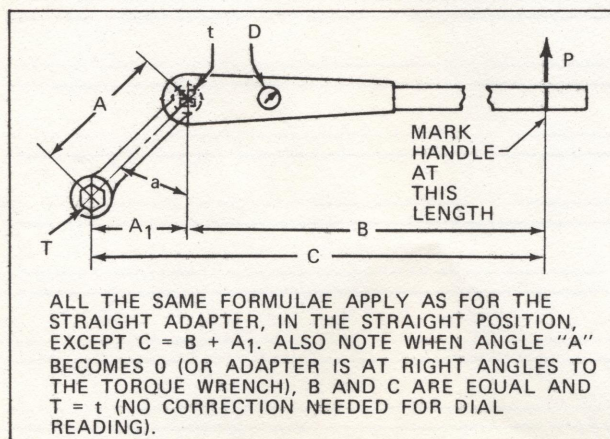


FIG. I-3. TORQUE WRENCH WITH ADAPTER APPLIED AT AN ANGLE.

TABLE I-IV
ENGLISH TO METRIC CONVERSIONS

Lb.-Ft. (Pound-Feet)	N·m (Newton-Meters)	kgm or mkp (kilogram meters or kilopond meters)
Conversions		
1.0000	1,3558	0,1382
0.7376	1,0000	0,1020
7.2330	9,8066	1,0000
Values (rounded to second decimal place)		
1.00	1,36	0,14
2.00	2,71	0,28
3.00	4,07	0,41
4.00	5,42	0,55
5.00	6,78	0,69
6.00	8,13	0,83
7.00	9,49	0,97
8.00	10,85	1,11
9.00	12,20	1,24
10.00	13,56	1,38
20.00	27,12	2,76
30.00	40,67	4,15
40.00	54,23	5,53
50.00	67,79	6,91
60.00	81,35	8,29
70.00	94,91	9,68
80.00	108,46	11,06
90.00	122,02	12,44
100.00	135,58	13,82
200.00	271,16	27,65
300.00	406,74	41,48
400.00	542,33	55,30
500.00	677,91	69,13
600.00	813,49	82,95
700.00	949,07	96,78
800.00	1 084,65	110,60
900.00	1 220,24	124,43
1000.00	1 355,82	138,25

EXAMPLE:

175 lb.-ft. = ? N·m

From Conversions:

175 X 1.3558 = 237,265 N·m ← ANSWER

From Table:

5 lb.-ft. = 6,78 N·m

70 lb.-ft. = 94,91 N·m

100 lb.-ft. = 135,58 N·m

175 lb.-ft. = 237,27 N·m ← ANSWER

NOTES:

NOTES:

TRANSPORTATION SYSTEMS BUSINESS DIVISION

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